

Claims 1-5 have been cancelled and rewritten in a form more commonly used in U.S. practice.

New Claim 6 corresponds substantially to original Claim 1.

New Claim 7 corresponds substantially to original Claim 2.

New Claim 8 corresponds substantially to original Claim 3.

New Claim 9 corresponds substantially to original Claim 4.

New Claim 10 is directed to the regenerated catalyst produced by the method of Claim 6. Support for this claim is found in Examples 1-10 of the specification.

New Claim 11 is directed to a process for the oxidation of unsaturated hydrocarbons in which the catalyst used is one which has been regenerated by the method of Claim 6. Support for this claim is found in original Claim 5.


The above amendments are believed to place this application in better form.

An action on the merits is respectfully requested.

Respectfully submitted,

MARKUS WEISBECK
ERNST-ULRICH DORF
GERHARD WEGENER
CHRISTOPH SCHILD
BERHARD LÜCKE
HERBERT DILCHER
ULRICH SCHÜLKE

By



Lyndanne M. Whalen
Attorney for Applicants
Reg. No. 29,457

Bayer Corporation
100 Bayer Road
Pittsburgh, Pennsylvania 15205-9741
(412) 777-2347
FACSIMILE PHONE NUMBER:
(412) 777-5449
/vjt/LMW3949

EXHIBIT 1

MoS_2 is one of the most active hydroprocessing catalysts, but it is expensive and the economical way to apply it is as highly dispersed material on a support, $\gamma\text{-Al}_2\text{O}_3$. The activity of the supported catalyst is increased by the presence of promoter ions, Co^{2+} or Ni^{2+} . The structures of the catalysts are fairly well understood; the MoS_2 is present in layers only a few atoms thick on the support surface, and the promoter ions are present at the edges of the MoS_2 layers, where the catalytic sites are located (100,101).

The catalysts are prepared by impregnating the support with aqueous salts of molybdenum and the promoter. In acidic solutions, molybdate ions are present largely in the form of heptamers, $[\text{Mo}_7\text{O}_{24}]^{6-}$, and the resulting surface species are believed to be present in islands, perhaps containing only seven Mo ions (100). Before use, the catalyst is treated with H_2 and some sulfur-containing compounds, and the surface oxides are converted into the sulfides that are the catalytically active species.

The applications of supported metal sulfides are unique with respect to catalyst deactivation phenomena. The catalysts used for processing of petroleum residua accumulate massive amounts of deposits consisting of sulfides formed from the organometallic constituents of the oil, principally nickel and vanadium (102). These, with coke, cover the catalyst surface and plug the pores. The catalysts are unusual in that they can function with masses of these deposits that are sometimes even more than the mass of the original fresh catalyst. Mass transport is important, as the deposits are typically formed with effectiveness factors less than unity, and in the extreme case the deposits block the pore mouths. Modeling of the transport/reaction phenomena has guided the preparation of catalysts with tailored pore structures to minimize the detriment of the deposits (103). These have been some of the most fruitful applications of the principles of chemical engineering in catalyst design and preparation.

Catalyst Development, Testing, and Production

Catalysts are discovered to meet processing needs and opportunities, but the discovery of a catalytic application to take advantage of some newly discovered material almost never occurs. Catalyst development is largely a matter of trial and error testing. The methodology was defined by Haber, Bosch, and Mittasch in the development of the ammonia synthesis process. Catalyst developers benefit from an extensive and diverse literature and often can formulate good starting points in a search for candidate catalysts by learning what has been used successfully for similar reactions. Deeper insights, such as would arise from understanding of the mechanistic details of a catalytic cycle, are usually not attainable; the exceptions to this rule largely pertain to molecular catalysis, usually reactions occurring in solution. Fundamental insights were valuable in guiding the development of the process for chiral hydrogenation and that for methanol carbonylation, among others, but it would be inappropriate to infer that understanding of the fundamental chemistry led to straightforward design of the catalysts. Indeed, the initial working hypothesis about the chiral hydrogenation turned out to be incorrect. The more complicated processes of surface catalysis are for the most part only partially understood even when the processes are established and extensive